A NEW SPECIES OF *BATRACHOSEPS* (SLENDER SALAMANDER) FROM THE DESERT OF SOUTHERN CALIFORNIA

By Arden H. Brame, Jr.[1]

Abstract: A new species of *Batrachoseps* is described from the lower desert slopes of the Santa Rosa Mountains. This species occurs in a small canyon tributary of Deep Canyon beneath limestone sheeting where there is perennial water seepage and below talus on the canyon floor during the wetter months. The closest relative of this desert slender salamander is *Batrachoseps stebbinsi* with which it agrees by having large feet, low numbers of trunk vertebrae, and a reduced phalangeal formula of 0-2-3-2. The new species, a broadheaded salamander, is primitive, and probably is a fragment of a once widely distributed form. *Batrachoseps stebbinsi, B. pacificus* and *B. simatus* possibly represent other fragments of the same ancestral population.

In the most recent review of the genus, Brame and Murray (1968), described three new species of *Batrachoseps* and elevated *B. major* to a full species. In addition, they compared the morphology and ecology of each of the then known species. They indicated that *Batrachoseps wrighti* is the most primitive species and is restricted to derivatives of Arcto-Tertiary plant communities of north-central Oregon. They considered *Batrachoseps relictus* to be close to the ancestral form that gave rise to all of the species in California and northern Baja California, and showed it to occur in four disjunct regions: (1) the Santa Lucia Range of Monterey and San Luis Obispo counties, (2) 1,000 to 8,000 feet elevation on the western slopes of the Sierra Nevada, (3) Santa Cruz Island off Santa Barbara County, and (4) 6,000 to 8,000 feet elevation in the San Pedro Martir Range of Northern Baja California, Mexico. In each of these areas, *Batrachoseps relictus* occurs within derivatives of Arcto-Tertiary or Arcto-Tertiary-Madro-Tertiary ecotonal communities. Brame and Murray suggested that *Batrachoseps stebbinsi* of the Piute and Tehachapi mountains in Kern County, *Batrachoseps simatus* of the Kern River Canyon, Kern County, and *B. pacificus* of the Northern Channel Islands off Santa Barbara and Ventura counties, probably arose from a *relictus*-like ancestor at an early time and possibly represent fragments of a once continuous species inhabiting primarily Arcto-Tertiary communities. *Batrachoseps attenuatus,* ranging from southwestern Oregon to southwestern California and the lower elevations of the western slopes of the Sierra Nevada, and *B. major* of southwestern California and northwestern Baja California are considered more recently derived forms from *Batrachoseps relictus.* Both have been able

[1]Research Associate, Section of Herpetology, Los Angeles County Museum of Natural History. (Present address: Eaton Canyon Nature Center, 1750 North Altadena Drive, Pasadena, California 91107.)

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to adapt to the drying trends of the Pleistocene and have successfully invaded the Madro-Tertiary floral communities. Brame and Murray discussed some dubious records for *Batrachoseps* from southwestern Alaska, the Nevada de Colima in Mexico, and the Cape region of southern Baja California, Mexico, the latter area being isolated by desert to the north and ocean or gulf on the other three sides. It is hoped that renewed interest in verifying these questionable records will now be stimulated based upon the unusual desert habitat for the new *Batrachoseps* species herein described.

Warden Russel W. Murphey of the California Department of Fish and Game, hiked down the steep east-facing desert slopes to a tributary of and above Deep Canyon, Riverside County, during the late summer of 1969, and found a moist water seepage area below the canyon cliffs. In order to create a small water hole for the native wildlife, he began pulling off the hard rock-like encrusted limestone overlying a moist sandy soil and granitic rock beneath and discovered, to his amazement, clusters of salamanders, the first desert record and the most eastern known salamander in California. Unfortunately these specimens died in captivity, but Warden Murphey, in the company of the author and James E. De Weese, returned to the locality early in 1970 and collected 8 additional specimens. The series of *Batrachoseps* proved to represent a new species, and due to the unusual arid environment for a salamander, I propose that it be known as:

Batrachoseps aridus, new species

Figures 1-5; Table 1

Suggested common name. Desert Slender Salamander.

Holotype. LACM 56271, an adult female from Hidden Palm Canyon, a tributary of Deep Canyon, elevation approximately 2500 feet, (10.5 miles by road S of the intersection of state Highways 111 and 74, town of Palm Desert), NW end of Santa Rosa Mountains, from slopes on western side of Coachella Valley, Riverside County, California; collected by Russel W. Murphey, James E. De Weese, and the author, February 27, 1970, (see map, Fig. 5, for locality and Figs. 1 and 2 of holotype).

Paratypes. LACM 56272-78 (7 specimens), collected with the holotype; and LACM 56570-80 (11 specimens), collected March 22, 1970, by Allan L. Reinholtz, Patricia L. Brame and the author.

Diagnosis. A moderately small species, 14 adults ranging from 30.3 to 48.4 mm (mean 37.4) in standard lengths; with short tails; and distinguished from all other species of *Batrachoseps* by its distinctive ventral coloration consisting of blackish maroon on belly and gular area, sharply contrasted with the flesh colored tail venter (see color pattern, Fig. 1); distinguished from all other species of *Batrachoseps* except *B. stebbinsi* by having an 0-2-3-2 hand and foot phalangeal formula (*B. attenuatus* rarely has an 0-2-3-2 formula); and distinguished from all other species of *Batrachoseps,* except *B. pacificus,* by having a proportionally broader head, standard lengths 5.7-7.4 (mean 6.5)

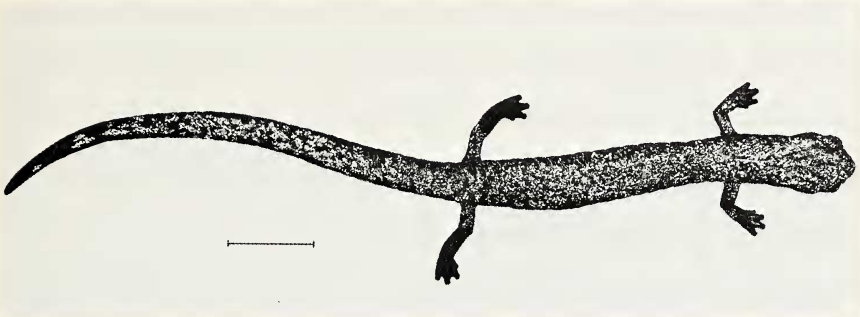

Figure 1. Holotype of *Batrachoseps aridus*, new species, LACM 56271, an adult female. Line equals 1 centimeter.

times head widths versus 7.0-8.1 (mean 7.4) in *pacificus* and greater than 7.5 for the other *Batrachoseps* species. See section on comparison for additional character differences between *Batrachoseps aridus* and the other seven species in the genus.

Description of holotype. An adult female, snout moderately short, somewhat pointed at tip; nostril moderately small, nasolabial groove well defined. Standard length 7.4 times head width; standard length 4.5 times snout-gular fold length. Eye large and protuberant. Well defined postorbital groove extends posteriorly from eye as shallow depression to three grooves that proceed sharply ventrally, for 2.2 mm to 1st groove which becomes the 1st nuchal groove ventrally, for 3.8 mm to the 2nd groove, which becomes the 2nd nuchal groove ventrally, and 5.7 mm to the 3rd groove which becomes the gular fold groove ventrally. The 1st nuchal groove is 2.8 mm and the 2nd nuchal groove is 1.8 mm anterior and parallel to the gular fold groove. Vomerine teeth 11 left, 12 right, extending diagonally in a posterior direction from the medial border of the internal nares, arranged in patches. Maxillary teeth 22 left, 23 right, extend about two-thirds through eye. Premaxillary teeth 10, not piercing lip. Intercostal grooves 18 per side. Tail short, 0.99 times standard length; dorsoventrally compressed at base but more rounded from middle to tip; not noticeably constricted at base. Postiliac gland not evident. Limbs very long, appressed limbs leave 6.5 intercostal folds uncovered; hind limb overlaps 5.5 intercostal folds; standard length 5.3 times right fore limb, 4.8 times right hind limb; coupling value 1.53 (axilla-groin length divided by combined hind and fore limb lengths). Webbing of hands and feet moderate, leaving 1 to 1.5 phalanges free of web. Fingers and toes with large subdigital pads except first digit, which has somewhat reduced pad; fingers in order of decreasing length: 3, 2, 4, 1; toes in order of decreasing length: 3, 2, 4, 1.

Osteological characters from x-ray of holotype. 20 trunk vertebrae; 2 caudal-sacral vertebrae; 19 ribs; phalangeal formula (both feet) 0-2-3-2,

(both hands) 0-2-3-2, terminal phalanges slightly expanded at tips; single premaxillary bone.

Measurements (in mm). Head width, 6.5; snout to gular fold (head length), 10.8; head depth at posterior angle of jaw, 2.7; eyelid length, 2.8; eyelid width, 2.0; anterior rim of orbit to snout, 2.2; horizontal orbital diameter, 2.0; interorbital distance, 1.2; distance between vomerine teeth and parasphenoid tooth patch, 1.0; snout to fore limb, 13.0; distance separating internal nares, 1.8; distance separating external nares, 1.8; snout projection beyond mandible, 0.8; snout to posterior angle of vent (standard length), 48.4; snout to anterior angle of vent, 45.8; axilla to groin length, 29.4; tail length, 47.8; tail width at base, 2.8; tail depth at base, 2.4; fore limb length, 9.2; hind limb length, 10.0; width of right hand, 2.6; width of right foot, 3.2.

Color in life. Dorsum blackish maroon, overlaid with an indistinct lighter dorsal band visible from the tip of the snout, top and sides of head; trunk dorsum, to four-fifths length of tail, composed of silver to brassy iridophores interspersed with some larger patches of metallic golden orange iridophores. Ventrally, the gular area and trunk are a darker blackish maroon, darker than dorsally, with numerous silver iridophores on the neck and some scattering on the gular surface. The tail venter is a pale pinkish brown (flesh colored) in marked contrast to the rest of the animal. The silver to brassy iridophores are also abundant on the upper arms and legs dorsally with a few scattered also on the fore arms. The iris is a deep blackish maroon with brassy iridophores.

Variation. There are no sexually dimorphic characters, other than the larger size of females and papillate vents of males. The holotype has the narrowest head (6.5 mm) at 48.4 mm standard length, and another female, LACM 56574, has the broadest head (6.4 mm), nearly the same head width at a much smaller size, 36.5 mm standard length. Aside from the somewhat striking variation in head widths, the series of *Batrachoseps aridus* is not too variable in other characters (see Table 1 for comparative measurements). All are quite similar in color to the holotype, except LACM 56571, a male, which is more of a uniform chocolate-brown in ground color with no iridophores present (see Fig. 1 for normal color pattern). The paratypes agree with the holotype in phalangeal formula, but 10 of the 18 paratypes have only 19 trunk vertebrae and 18 ribs, whereas 7 agree with the holotype in having 20 trunk vertabrae and 19 ribs. In six paratypes, tibial spurs can be seen (probably present in all *Batrachoseps aridus,* but difficult to see in x-rays). One paratype, LACM 56574, has multiple vertebrae fusions with four pairs of ribs extending from one fusion and three left, and two right from another fusion, so its vertebral count was not incorporated above.

Comparison. In addition to the characters discussed in the section on diagnosis, *Batrachoseps aridus* is distinguished from all other species of *Batrachoseps* by having proportionately longer heads, standard lengths 4.1-4.7 (mean 4.4) times snout-gular fold lengths (= head lengths); by having

proportionately longer limbs, standard lengths 4.0-4.8 (mean 4.4) times right hind limb lengths; costal folds left uncovered by appressed limbs (= limb interval) 3.5-6.5 (mean 5.0); coupling values (right hind limb length + right fore limb length divided into axilla-groin length) 1.08-1.53 (mean 1.31); by having proportionately larger feet, standard lengths 12.5-15.1 (mean 13.7) times right foot widths; costal grooves 16-19 (mean 17.8) per side (see Brame and Murray, 1968: 28-29, Table 5, for comparative data for the other seven species of *Batrachoseps*); and by its distinctive coloration of black to chocolate-maroon ground color dorsally with an indistinct band composed of hundreds of separated silver to brassy iridophores intermixed with orange-gold patches of iridophores on front part of head, trunk, first four-fifths of tail, sides of head, neck and shoulders, and silver iridophores scattered on gular surface and abundant on neck venter region; venter of trunk darker than dorsum and more of a darker maroon-black, tail flesh colored ventrally in marked contrast to trunk venter. Distinguished from its apparent closest relative, *Batrachoseps stebbinsi,* by its smaller size, 30.3-48.4 (mean 37.4 mm) standard lengths versus 50.8-60.4 (mean 55.2 mm); by its proportionately broader head, standard lengths 5.7-7.4 (mean 6.5) times head widths in contrast to 7.5-8.4 (mean 8.0) for 10 *B. stebbinsi;* by its proportionately longer head, standard lengths 4.1-4.7 (mean 4.4) times snout-gular fold lengths versus 4.5-5.4 (mean 5.1) for 10 *B. stebbinsi*; by its proportionately longer limbs, standard lengths 4.0-4.8 (mean 4.4) times right hind limb lengths compared to 4.5-5.1 (mean 4.8) for *B. stebbinsi*; coupling values for 18 *B. aridus* = 1.08-1.53 (mean 1.31) versus 1.38-1.62 (mean 1.51) for 10 *B. stebbinsi;* costal folds uncovered by appressed limbs 3.5-6.5 (mean 5.0) in contrast to 6-7 (mean 6.25) for 10 *B. stebbinsi*; by having proportionately broader feet, standard lengths 12.5-15.1 (mean 13.7) times right foot widths compared to 13.9-16.4 (mean 14.7) for 10 *B. stebbinsi;* by having usually one-half to one more costal grooves per side of trunk, costal grooves 16-19 (mean 17.8) per side versus 18-19 (mean 18.5) for 10 *B. stebbinsi* (trunk vertebrae 19-20 (mean 19.4) for *B. aridus* and 20 for *B. stebbinsi*); and by marked differences in coloration (see color pattern, Figs. 1 and 2, and Brame and Murray, 1968: 20); basic color differences are presence of distinct dorsal band (often beige), presence of distinct solid or broken dorsolateral black stripes, ground color of venter and tail black, white iridophores abundant ventrolaterally though mostly absent midventrally except on gular area, shoulders, and neck; iris light brown with brassy iridophores for *B. stebbinsi* in contrast to the coloration of *B. aridus* which has an indefinite dorsal band composed of hundreds of scattered silver to brassy iridophores and some gold-orange patches of iridophores on a dark black-maroon to chocolate-maroon ground color; dorsolateral stripes absent, ground color of venter blackish-maroon except for tail which is flesh color; silver iridophores absent both ventrolaterally and midventrally except on shoulders, neck and gular area, and iris very dark black-maroon with brassy iridophores. *Batrachoseps aridus* and

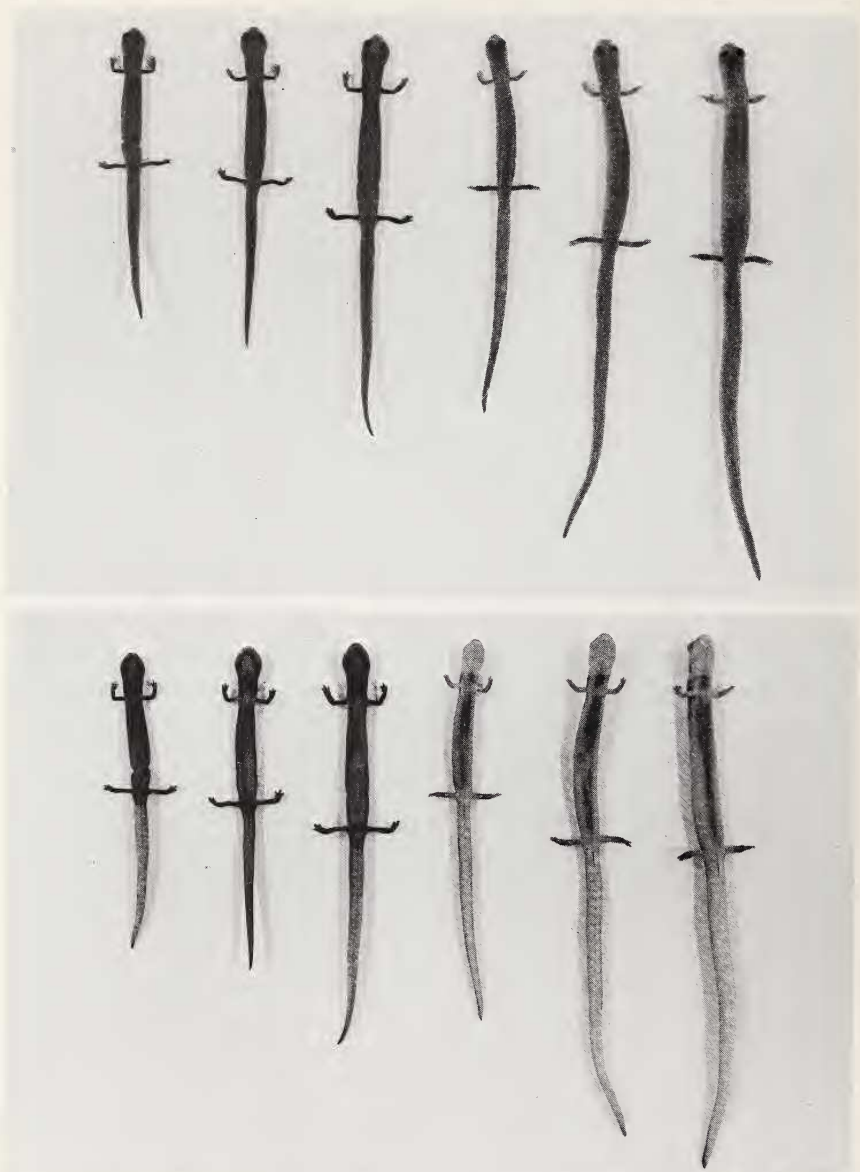

FIGURE 2. **Upper:** dorsal views of 3 *Batrachoseps aridus,* new species, at left, from left to right–LACM 56573, LACM 56272, and the holotype, LACM 56571, all from the type locality; and 3 *B. major* at right, from left to right–LACM 56283, LACM 56281, and LACM 56280, all from W. Exposition Blvd. between 5th and 10th Avenues, Los Angeles. **Lower:** ventral views of the same individuals in the same order.

B. stebbinsi are the only *Batrachoseps* to have a phalangeal formula of 0-2-3-2 for the feet although it occurs rarely in *B. attenuatus*. The normal phalangeal formula for the other six species (including *attenuatus*) is 1-2-3-2.

Habitat. The type locality is located on the lower eastern slope of Black Hill, about 500 feet elevation below State Highway 74 (= Pines to Palms Highway). The exposed slopes, both east and west above Hidden Palm Canyon, have a flora composed largely of cholla, agave, barrel cactus, prickly pear cactus, creosote, manzanita, juniper and mesquite. The canyon floor flora is dominated by sugar bush, willow, Washington palms, creosote, mesquite, and various grasses, and mosses, algae and maiden-hair fern on the perpetually shaded north and west facing cliff-like walls of the canyon. A continu-

Figure 3. View down the east facing slope with cholla and agave in the lower right corner of the picture; the canyon floor at the left center of the picture with the prominent Washington palms; the well shaded west facing slope in the background, composed of limestone deposits overlying sand and granitic rock beneath; the type locality of *Batrachoseps aridus*, new species, at the base of this slope and several yards up the canyon (hidden from view) to the right (south). This locality is Hidden Palm Canyon, about 2500 feet elevation. (See text for additional type locality description and data, and map, Fig. 5.)

ous water seepage occurs at various areas along these cliffs and is apparently much more widespread in wetter years judging from the extensive sheet-like calcium carbonate (limestone) deposits. Many of the *Batrachoseps aridus* were taken beneath sheets of limestone during the late summer of 1969[1], but only a few were found there during February and March, 1970. Most of these were taken beneath rocks at the lower level of the cliffs or at the base of the north and west facing cliffs or in rock talus. The soil underneath the limestone sheets and talus rocks appears to be composed largely of coarse sand intermixed with small granitic rocks. Sugar bush is abundant at the base of the north and west facing cliffs (see habitat views, Figs. 3 and 4).

Range. Known only from the type locality (see map Fig. 5).

Evolutionary relationships. Morphologically, *Batrachoseps aridus* is closer to *B. stebbinsi* than to other species, and it possesses the proportionately broadest head, longest limbs and biggest feet of all species. It also has fewer

FIGURE 4. View of the type locality of *Batrachoseps aridus*, new species, the majority of the type series being taken from the talus slope at the lower right of the picture. A few were collected beneath the limestone sheeting at the left center. Water seepage occurs beneath the limestone and talus.

[1]On July 25, 1970, 10 additional specimens (LACM 61272-61281) were obtained from beneath and within moderately soft porous limestone at the type locality, thus confirming that this species is active in the summer months.

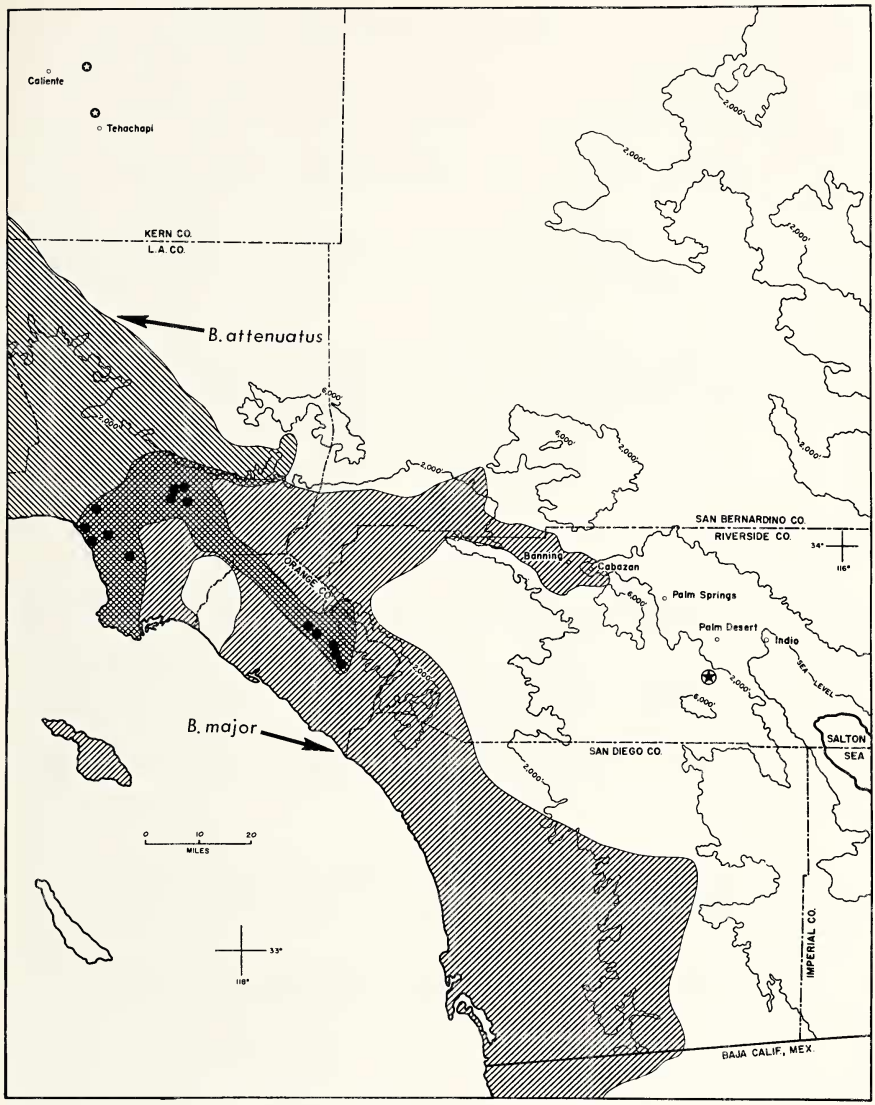

Figure 5. Map of southern California showing the type locality for *Batrachoseps aridus*, new species (solid star in open circle). The two localities for *Batrachoseps stebbinsi* are indicated by the open stars inside solid circles. The ranges of *B. major* in the southwest and *B. attenuatus* in the northwest are shown. Cross-hatching indicates the region of geographic overlap. Actual localities of sympatry between *B. major* and *B. attenuatus* are indicated by solid circles.

TABLE 1 Measurements and data for *Batrachoseps aridus*

	Sex	Standard Length	Axilla-Groin Length	Head Width	Hind Limb Length	Fore Limb Length	Intercostal Grooves	Limb Interval[a]	Coupling Value	Maxillary Teeth	Vomerine Teeth	Tail Length	Foot Width	Head Length
LACM 56271[b]	♀	48.4	29.4	6.5	10.0	9.2	18	6.5	1.53	22-23	11-12	47.8	3.2	10.8
LACM 56272	♀	40.9	23.7	6.2	8.9	8.0	17.5	5.5	1.40	23-23	12-10	35.0	3.0	9.2
LACM 56570	♀	40.6	24.1	6.0	9.2	8.2	18	6	1.38	21-19	10- 9	38.4	3.0	8.7
LACM 56573	♀	36.9	21.3	5.8	8.0	6.8	18	5.5	1.44	16-17	9-10	33.2	2.9	8.2
LACM 56574[c]	♀	36.5	19.5	6.4	9.0	8.2	17[c]	3.5[c]	1.13[c]	24-21	11-10	35.1	2.8	9.0
LACM 56576	♀	36.3	21.3	5.4	8.0	7.2	18.5	5	1.40	15-17	8-10	31.7	2.6	8.2
LACM 56575	♀	35.3	20.7	5.6	8.2	7.2	18	5.5	1.34	19-19	8-10	30.1	2.5	7.9
LACM 56275	♀	32.2	18.4	5.2	7.5	7.0	18	5	1.27	16-17	9- 8	27.8	2.4	7.8
LACM 56577	♀	31.1	18.2	4.8	7.0	6.6	18	5.5	1.34	17-14	9- 9	24.0	2.2	7.1
LACM 56273	♂	40.0	22.8	5.9	8.6	7.6	18	6	1.41	19-17	8- 9	32.8	2.8	8.8
LACM 56571	♂	39.3	23.0	5.9	8.7	7.8	18	6	1.39	21-17	9-12	36.2	2.8	8.3
LACM 56572	♂	38.0	21.3	6.2	8.5	7.7	18	5	1.31	19-16	10-10	33.8	2.7	8.9
LACM 56274	♂	37.1	21.1	5.6	8.7	7.8	16.5	4	1.28	16-20	10- 8	24.3[d]	2.8	8.0
LACM 56276	♂	30.3	17.4	4.7	7.0	6.4	18	4.5	1.30	17-13	5- 7	15.7[d]	2.2	7.2
LACM 56578	juv.	29.8	16.8	4.8	6.9	6.7	18	4.5	1.24	15-18	7- 8	22.8	2.2	7.0
LACM 56579	juv.	29.4	16.4	4.6	7.3	6.3	17	4.5	1.21	15-15	6- 8	23.9	2.0	6.8
LACM 56277	juv.	28.5	16.2	4.3	6.8	6.2	18	4	1.08	17-16	7- 8	20.3	2.1	6.7
LACM 56580	juv.	27.6	15.7	4.5	6.9	6.2	18	4	1.20	13-13	6- 7	21.8	2.2	6.8

a = Number of intercostal folds left uncovered when the limbs are appressed to sides. b = Holotype.
c = Aberrant specimen with multiple vertebral fusions. d = Regenerated or broken tails.

trunk vertebrae, 19-20 (mean 19.4), and costal grooves, 16-19 (mean 17.8) except for some populations of *B. relictus* and all *B. wrighti* which have one to two less. These characters can all be classified as primitive and I believe *Batrachoseps aridus* evolved early, probably from a common ancestor of *B. stebbinsi.* Now it is apparently restricted to a spring-fed, protected canyon in an arid desert and possibly to other suitable relict "oases" and similar habitats in nearby regions, whereas *B. stebbinsi* is restricted to the two small area localities in the Piute and Tehachapi mountains of Kern County about 160 airline miles to the northeast in a pine-oak and riparian habitat (see map, Fig. 5). To a lesser extent, *Batrachoseps aridus* is related also to *B. pacificus* of the Northern Channel Islands and more remotely to *B. simatus* of the Kern River Canyon of Kern County. The four species, *B. aridus, B. stebbinsi, B. pacificus* and *B. simatus,* may represent fragmentations of a once widespread species. (See Brame and Murray, 1968: 27-34 for discussion of species relationships and evolution of the genus.)

Remarks

Additional search should be made of well shaded desert canyons, especially in places where there are limestone deposits and perennial water seepage. Because of the limited extent of the habitat (the limestone sheets could easily be decimated) of *Batrachoseps aridus,* I strongly urge that it be placed on the official red book list of rare and endangered species (U.S.A. and International); steps should be taken to protect this unusual habitat and its interesting occupants. A similar action has already been taken with regard to *Batrachoseps stebbinsi.*

Acknowledgments

My chief debt of gratitude is due Russel W. Murphey who discovered *Batrachoseps aridus* and who kindly led me to the locality. Further, I greatly appreciate the field aid of James E. De Weese of the University of Southern California, Allan L. Reinholtz and Patricia L. Brame. The latter prepared the illustration of the holotype. John W. Wright kindly reviewed the manuscript and made many useful suggestions. I am grateful to William Presch for x-raying the entire series.

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